CIRCULARS OF INFORMATION

OF THE

BUREAU OF EDUCATION.

No. 5—1881.

CAUSES OF DEAFNESS AMONG SCHOOL CHILDREN AND ITS INFLUENCES ON EDUCATION, WITH REMARKS ON THE INSTRUCTION OF PUPILS WITH IMPAIRED HEARING AND ON AURAL HYGIENE IN THE SCHOOLS, BY SAMUEL SEXTON, M. D., AURAL SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY, MEMBER OF THE AMERICAN OTOLOGICAL SOCIETY, &c.

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LETTER.

DEPARTMENT OF THE INTERIOR.
BUREAU OF EDUCATION,
Washington, September 24, 1881.

SIR: The causes of deafness among school children are numerous and important enough to justify a special investigation of the subject, and I have requested Dr. Samuel Sexton, a distinguished aural surgeon of New York City, to prepare a paper on the subject.

The author has collected in the following pages some of the more practical conclusions regarding the causes of deafness among school children, together with suggestions of a hygienic and prophylactic nature drawn from his own observations among a large number of pupils in dispensary, hospital, and private practice.

Before commencing the general discussion of the subject, the writer deems it expedient to give a brief description of the structure of the ear, together with its physical and physiological functions, including the modus operandi of hearing.

The woodcut illustrating the deeper and invisible portions of the ear, it is believed, will materially aid the reader in arriving at a useful knowledge of the subject.

The sympathetic relations between the teeth and the ears are also fully considered, the influence of diseased states of the former on the acoustic organs of youth seeming to demand particular attention.

I would, therefore, respectfully request its publication as a circular of information.

I have the honor to be, your obedient servant,

JOHN EATON,
Commissioner.

The Hon. the SECRETARY OF THE INTERIOR.

Publication approved.

S. J. KIRKWOOD,
Secretary.

DEAFNESS AMONG SCHOOL CHILDREN.

STRUCTURE OF THE EAR.

From a study of Fig. 1 it will be seen that quite a large passage seems to traverse the base of the skull from ear to ear; this passage, however, does not extend directly athwart the head in such a manner as to im-

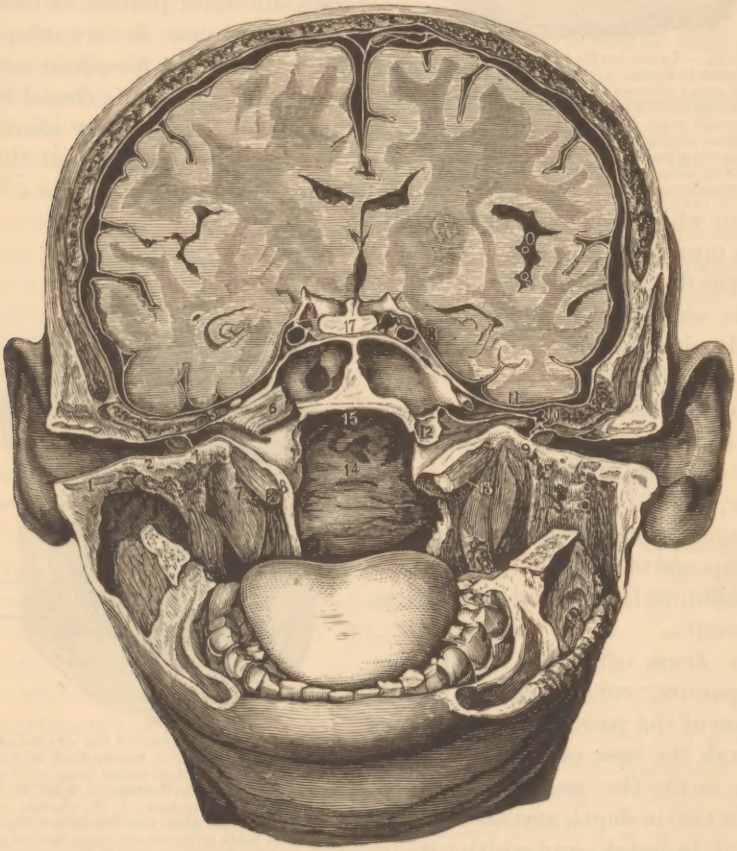

FIGURE 1.—(After Ridinger).—Section through the head showing the auditory canal, drum, drum-head, and Eustachian tube of each side. 1, cartilage of the external auditory canal; 2, bony portion of external auditory canal; 3, 4, drum membrane of the right side; 5, drum cavity; 6, dilator muscle of the Eustachian tube; 7, 13, muscles which lift the soft palate; 8, mucous membrane of the pharyngeal orifice of the tube; 9, drum membrane of the left side; 10, hammer bone; 11, muscle which renders the drum membrane tense; 12, mucous membrane of the Eustachian tube; 14, 15, mucous membrane of the posterior surface of the pharynx.

[1]The writer desires to acknowledge his indebtedness to Wm. Wood & Co., of New York, and Presley Blakiston, of Philadelphia, who have kindly loaned several of the cuts made use of in the following pages.

mediately connect the two ears together, for its connection is broken, as it were, in the pharynx, where it opens by two separate mouths.

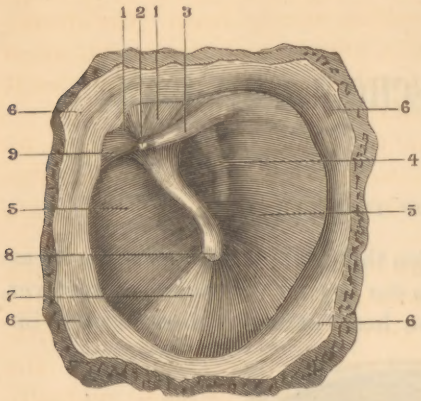

FIGURE 2.—Outer surface of the drum head, magnified about 3½ times. 1, the flaccid part of the drum-head; 2, short process; 3, the back fold of the drum-head; 4, the anvil's long and descending limb shining through from behind the drum membrane; 5, 5, the true membrane; 6, 6, 6, 6, inner end of bony canal forming frame for drum-head; 7, the pyramid of light; 8, lower part of the hammer; 9, the front fold of the drum-head.

A description of the passage of one side will be sufficient, inasmuch as both are alike. From where the passage enters the head at the auricle—ear, in common parlance—to its inner termination in the pharynx, it measures about two inches and a half.

The *external auditory canal* comprises the outer portion of this passage; its course is inwards, with slight deviations, for about an inch and a half, where it is closed by the drum-head. It is nearly round, seldom large enough to admit the end of the little finger, and has a lining of skin which becomes very delicate at its inner end where it is reflected over the drum-head. The wax of the ear is secreted by numerous small glands situated near the centre of the auditory canal.

The *drum-head*,[1] or membrana tympani (Figures 2 and 3)[2], consists of a very thin skin, no thicker than tissue paper, which is stretched across the passage and closes in the drum. It is composed of three layers; the middle or fibrous layer being tough, gives it strength.

The *drum cavity*, or middle ear (tympanum), consists of the middle portion of the passage where it goes through the base of the skull. The drum is for the most part only a line or two in depth and about a half an inch in height and width; its inner wall, which consists of an irregular surface of bone, is perforated in

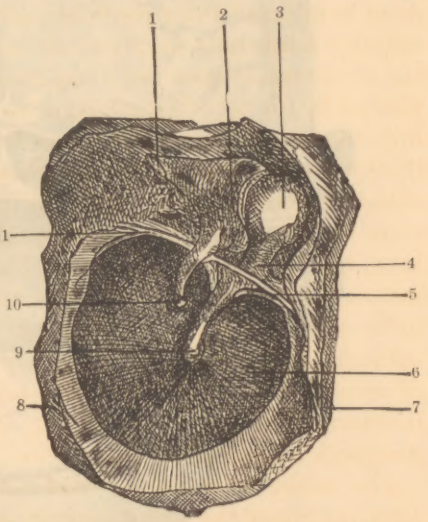

FIGURE 3.—Inner surface of the drum-head, magnified about 3½ times. 1, short limb of the anvil, attached to back part of outer bony wall of drum cavity; 2, body of anvil bone; 3, head of hammer bone; 4, neck of hammer; 5, 11, chorda tympani nerve (this marks also the boundary line of the pockets and folds of the drum-head, the latter being shown in Fig. 2, at 1 and 5); 6, front part of drum-head; 7, 8, bony frame around drum-head; 9, the lower part of the handle of the hammer bone; 10, lower part of the long limb of anvil bone; to the point 10 the head of the stirrup bone is attached.

[1] The drum-head is liable to be incorrectly spoken of as the drum itself. As in the musical instrument known as the drum, the ear drum has a membranous cover (drum skin) which covers a hollow cavity (drum) containing air. The drum of the ear contains not only air but also the ear bones.

[2] From Hearing, and How to Keep It, by Charles H. Burnett, M. D.

two places, the openings leading into the labyrinth but closed by membrane; one of these openings receives the stirrup bone. The drum's dense bony case and its deep situation afford protection to the sound transmitting mechanism which it contains, and its unyielding walls allow of precision in the movements of the mechanism.

The drum-head veils the drum cavity outwardly, but owing to its translucency a glimpse is afforded of some of the structures within. The brain lies above the drum and is separated from it by a very thin plate of bone.

The Eustachian tube.—The inner portion of the passage which extends from the ear to the throat takes a somewhat downward course from the drum to its inner termination; this portion of the passage is a little more than an inch in length and is known as the Eustachian tube. The tube is very small where it leaves the drum, but it becomes gradually larger, and finally expands at its termination into quite a large trumpet-shaped mouth. The pharynx, which receives the inner extremity of the tube, is the superior termination of the air passages, and by means of this tube the air is conveyed upwards to the drum of the ear. The Eustachian tube is lined with mucous membrane. The mucus secreted in the drum cavity and along the tube passes into the throat. The drum cavity requires a constant supply of air from the throat in order to counteract the air pressure upon the drum membrane from without; this is accomplished by the act of breathing, every bellows-like movement of the lungs forcing little jets of air up through the Eustachian tube to the ear. Sound probably travels from the mouth to the ear through this tube, but we are unconscious of the fact unless the ear is diseased. The tube is liable to closure from colds, chronic nasal catarrh, and other causes, in consequence of which mucus is confined in the ear and the normal air supply is cut off. These disorders impair the hearing.

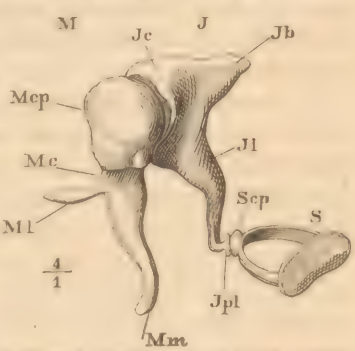

FIGURE 4.—Ear bones, or ossicles of the ear, in mutual connection, seen from the front and from the right side of the head, turned a little to the right round a vertical axis. M, hammer, or malleus; J, anvil, or incus; S, stirrup, or stapes; Mcp, head; Mc, neck; Ml, long process, or processus gracilis; Mm handle, or manubrium, of the hammer; Jc, body; Jb, short process; Jl, long process; Jpl, orbicular process, or os orbiculare, or processus lenticularis, of the anvil; Scp, head, or capitulum, of the stirrup. The three ear bones are shown here enlarged four diameters. (Helmholtz.)

The sound transmitting mechanism.—That portion of the acoustic organ which sound waves set in motion is lodged in the drum cavity, whose deeply seated bony case affords it protection, besides providing the unyielding attachment which is necessary for the performance of its functions. Besides the drum-head, or drum skin, as it is sometimes called, there are three ear bones concerned in this mechanism for the transmission of sound, namely: (1) The *hammer bone*, or malleus, which is joined to the top of the drum cavity; its handle comes down between

the layers of the drum-head and is moved to and fro with every vibration of the membrane. (2) The upper portion of the hammer is articulated to the *anvil bone*, or incus, to which all of its to and fro movements are communicated. (3) The anvil has a slender process projecting down into the drum cavity on the end of which is attached the *stirrup bone* or stapes. The foot plate of the stirrup bone fits like a piston into one of the holes that lead from the drum cavity to the inner ear or labyrinth. Thus we have a chain of small bonelets extending from the drum membrane to the labyrinth; any impulse imparted to the drum membrane is immediately transmitted to the stirrup bone, which is driven with a piston-like motion into the labyrinth. The *mastoid cells* are small cavities of irregular size, the whole assemblage occupying a space as large as an almond, in the mass of bone which may be felt projecting behind the auricle. There is a direct communication between them and the drum, and they are liable to visitations of an inflammatory nature when it is affected.

The inner ear or labyrinth.—The affections of the inner ear are influenced so little by ordinary hygienic measures that I shall not attempt its description here. Should the reader feel inclined to acquire a knowledge of this part of the ear he will find the subject ably treated in the very interesting little book on Hearing, and How to Keep It.[1]

The modus operandi of hearing.—The passage that extends from the auricle to the throat is mainly an aërial conduit; the currents of air entering it at either extremity would intermingle were it not for the head of the drum which is stretched across the passage. The thin skin composing the drum's head vibrates freely to all sounds from without near enough to disturb the air in contact with it, thus affording the motive power that sets the sound transmitting mechanism in motion. The aërial vibrations of which sound is composed, entering the ear through the external auditory canal, excite responsive movements of the drum-head similarly to the impulses of wind that move the sails of a windmill; with this difference, however, the sails of the mill receive the air impulses obliquely upon a plane surface which causes them to revolve, while the drum-head, being immovably attached to the bony walls of the auditory canal at its entire circumference and receiving the impulses of sound on a slightly concave surface, is simply driven inward by each sound-wave, its peculiar construction causing it to instantly return to its former position after each inward movement. Now every time the drum-head performs a to and fro movement the ear bones partake of the motion, and the stirrup, which fits like a piston into one of the orifices between the middle and inner ear, thus imparts an impression of each vibration to the nerve of audition. Every sound thus seems to cause a particular kind of plunge on the part of the piston. The range of the sound transmitting mechanism's movements is very remarkable; thus it has been determined by scientific experiments that its to and fro

[1] Hearing, and How to Keep It, by Charles H. Burnett, M. D. Philadelphia, Presley Blakiston, 1880.

movements exceed forty thousand per second in response to the higher notes, while shocks of sound requiring no more than sixteen vibrations per second may still be appreciated. It will thus be seen that the transmitting mechanism is capable of such rapid movements that the most intricate musical sounds impart their rhythm to the sense of hearing without any inharmonious break.[1]

It is but fair to state that some authorities hold to the belief that the sound transmitting mechanism is incapable of presenting compound tones to the perceptive faculties as a whole, but that the function of the nerve of audition is to take cognizance of the separate elements of tones.

Noises in the head, or tinnitus aurium.—The transmitting mechanism in health does not permit sound to be heard through any other channel than the auditory canal; confusion naturally results, therefore, when unusual sounds are permitted to excite the auditory nerve irrespective of the motor of normal hearing. Sounds, therefore, that reach the sense of hearing by exciting the piston-like action of the stirrup bone, or otherwise, without the aid of the drum-head, interfere with the sounds which continue to be perceived as usual; hence vibratory movements arising from the circulation of the blood in the head, or from other physiological performances which are thus abnormally heard, constitute noises in the head. (See pages 21, 39.)

Autophony.[2]—When the hearing motor, the drum-head, loses its tension, or when any of the ear bones become separated from each other, sound in the external auditory canal sometimes fails to cause effectual movements of the mechanism; the hearing is then variable, one moment the voice and noises in the head are all heard confusedly together, and the next moment better hearing is experienced. Autophony and tinnitus aurium are symptoms that confuse the individual very much, although he may enjoy quite good hearing when the temporary interference is absent. (See pages 20, 39.)

CAUSES OF DEAFNESS AMONG SCHOOL CHILDREN.

The sense of hearing is impaired by so many causes to which children are exposed, many of them almost unavoidable, that it is unusual to meet with a child that has not experienced some aural disease. If we accept the statement as approximately correct that of the entire population not more than five in every hundred possess unimpaired hearing, some idea at least can be formed of the prevalence of this defect in youth.

The numerous causes of deafness are found to be distributed among all the different regions of the ear, and it will, therefore, be most convenient to consider them, as nearly as may be, in connection with the

[1] See Dr. Charles H. Burnett's interesting researches on this subject, Arch. Oph. and Otol., vol. II, No. 2, p. 45.

[2] Autophony, from *αὐτός*, self, and *φωνή*, voice—a symptom in aural affections causing the patient when speaking or singing to fancy that his own voice comes from within the head, instead of leaving the mouth and going around to the ear as usual. The voice of the affected person can, however, be heard by others.

part affected; I shall first allude to local causes, and then to such as are remote or general.

I. LOCAL CAUSES.

Affections of the auricle.—The auricle is liable to become inflamed from blows or when frosted; it may then swell up greatly and close the entrance to the auditory canal, thus causing more or less deafness; a like result sometimes follows an attack of eczema, or salt rheum, an affection to which some children are subject. Deafness from these causes is not very frequent, however.

Affections of the external auditory canal.—The auditory canal being easily inspected under a good light, any object that obstructs it can be readily discovered. The foreign bodies that are found in this canal usually consist of small objects that children themselves or their companions have carelessly introduced in play. Although these obstructions are usually visible to the eye, their removal is found to be by no means an easy task, as will appear further on.

Wax may collect in the canal and cause deafness by excluding sound, or it may become loose in the passage and lodge against the drum membrane, when intolerable noises in the ear will be experienced. Foreign bodies, by exciting the secretion of wax or by preventing its escape in the natural way, may give rise to deafness. The canal is also liable to be closed by inflammation. (See page 36.)

Affections of the drum [the drum-head, although constituting the hearing motor, is yet anatomically inseparable from the drum and always participates in its affections].

Injuries to the drum from violence.—The drum is vulnerable to violence from without. Slight blows upon the ear or striking upon it in falling may cause its injury; thus, a slight *box on the ear* by the hand, suddenly compressing the air in the auditory canal, may rupture the membrane. Small implements such as are commonly carried about the person are sometimes violently thrust into the drum by sudden movements or unexpected blows while they are being used in the auditory canal. These injuries, which are, fortunately, of rare occurrence, involve to a greater or less extent the whole drum, the laceration and concussion being attended by other grave results. (See page 37.)

Affections of the inner ear, or labyrinth.—The consequences of impairment of the nerve of hearing are usually very grave. There are a few diseases characterized by severe brain symptoms which are singularly obnoxious to this region, mainly through the extension of inflammation to the auditory nerve and its surroundings; cerebro-spinal meningitis is an example of such affections, often leaving complete and incurable deafness. The affections of this region are but little influenced by hygienic measures.

II. AFFECTIONS OF THE EAR FROM NERVOUS SYMPATHY.

Affections of the ear from sympathy of the nerves occur more frequently than from any other cause; they are characterized by the insid-

iousness of their approach, serious injury to the organ of hearing often taking place without being heralded by any symptom of warning. Generally, however, there are appreciable symptoms which attract the patient's attention, although they may not always at first seem to threaten the ear. Perhaps the most frequent precursor of these is taking cold.

Taking cold in the head.— In order to understand fully the significance of taking cold in the head through sympathy of the nerves, it would be well to explain the peculiar character of the parts involved.

The cavity of the nose, the region chiefly affected, enjoys an immense expanse of mucous surface, far greater in extent than the modest external aspect of the organ would indicate; thus, where the cavity of the nose expands into the throat behind, its passages are greatly convoluted and an extensive and tortuous cavern is thus constituted. This posterior and much expanded portion of the nasal cavity is covered by a highly vascular mucous membrane—the Schneiderian membrane—which is easily irritated, either by the entrance of particles of dust or by the reflex irritation to be described below. At the beginning of a cold in the head the blood vessels of this membrane become engorged, when the flow of mucus, which is naturally secreted in moderate quantities, is usually very much increased. The phenomena of a nasal catarrh are now soon manifest.

The modus operandi of taking cold in the head through sympathy of the nerves should be fully comprehended if we would wish to prevent aural disease by means of hygienic measures. In order to clear the way to an explanation it may be permitted to draw attention to some familiar phenomena which are due to the reflex action of the nerves or nervous sympathy; thus, certain individuals are known to be subject to flushing from slight causes, in explanation of which it may be said that a shock has been experienced from a mental impression which serves to paralyze the nerves controlling the blood supply about the head; the face is then instantly flushed, and in extreme cases dryness of the throat is experienced, and the head becomes hot from the sudden rush of blood into the arteries. The paralyzing effect is usually of temporary duration, the nerves regain their normal power, and the flushing and other symptoms are no longer experienced. In the more decided cases, however, pallor and dizziness succeed to the rush of blood. Another example suggests itself in the earache of dental irritation; pains in the ears are thus experienced in some instances from the cutting of a tooth or from dental decay, even without any irritation being felt in the mouth.

A cold in the head may arise from an exposure during which a current of cold air is allowed to fall upon the unprotected head and shoulders; the local shock from the draught of cold air is usually too mild to be observed by the person who has been thus exposed, but the nearest nerve centres which are concerned in the reflex action, and which are connected

with the spinal cord, have branches distributed to the exposed regions of the head and neck; they also maintain, by other small branches, communication with the mucous membrane in the nose and influence the blood supply in the latter region. In health the tone of the arteries is maintained by these nerves, which are called "sympathetic," but the shock occasioned by the draught of cold air serves to impair their functions and they become immediately paralyzed. This temporary paralysis of the nerves is promptly followed by an expansion of the blood vessels in the mucous membrane of the nose, when congestion ensues and the mucous secretion is increased. The result of an exposure to cold draughts is not invariably a cold in the head — a "stiff neck" may ensue.

During the existence of most head colds the ears are exceedingly liable to be involved: thus, the Eustachian tubes may be obstructed by the swelling of their mucous membranes, when the usual air supply of the drum cavity will be cut off; or, the catarrhal inflammation may extend from the throat up the Eustachian tubes and thence into the drum cavity. Both of these conditions usually coexist and give rise to much deafness.

But the ear may be affected without this catarrhal extension through the Eustachian tube. Thus, an independent inflammation may arise in the ears through the nervous sympathy existing between them, the throat, or nose.

In a certain number of instances the effect of taking cold may be manifested in the ear alone, the naso-pharnyx escaping entirely. The aural complication is announced by a "stuffy" feeling in the ears; there are noises and autophony experienced and more or less deafness. (See pages 28, 29.)

Dental irritation. — By referring back to the modus operandi of taking cold, it will be readily understood how any dental irritation may give rise to aural disturbances, for the nervous relationship between the teeth and the ears is most intimate. In this manner many affections of the ear which were formerly attributed to other influences may now be accounted for.[1] The reflected neuralgias from dental caries are quite familiar to most readers, but it frequently happens that, through the nervous influence referred to, a morbid action is set up in the ears, and continues almost indefinitely without being attended with any marked pain in either the teeth or the ears, and therefore without attracting the patient's attention. But in a great many instances pain, either in the teeth or ears or in both, is a prominent symptom. The modus operandi of these sympathetic aural troubles is well illustrated in the accompanying diagram,[2] which shows the nervous connection between a carious tooth and the drum-head. The drum-head, it will be seen, is in part supplied by a small artery (indicated at 8 in the figure on page

[1] See the author's prize essay "On affections of the ear arising from diseases of the teeth," Am. Jour. Med. Sciences, Jan., 1880.

[2] The diagram is from Woakes; see his work on deafness, giddiness, and noises in the head. Presley Blakiston, Philadelphia, 1880.

15), which is under the influence of the vaso-motor (sympathetic) nerves of the carotid plexus, which at this part come largely from the otic ganglion (4). From the source of irritation in the carious tooth a nerve (7) also communicates with the same ganglion (4). A line of nerve communication is now established, through the otic ganglion, between the teeth and vascular supply of the drum-head. The effect of irritation in the teeth or gums will be to excite vessel dilatation in the arteries supplying the drum-head, when hyperæmia or even inflammation will result. This, of course, is only an illustration of an injury to a small portion of the organ; sometimes the drum cavity is thus affected, and when the sympathetic influence is characterized by chronicity, trophic changes may go slowly on, causing great injury to the ear without exciting any attention until hearing is seriously impaired.

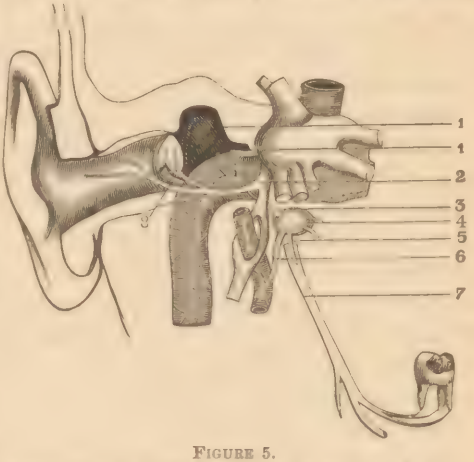

FIGURE 5.

With this brief explanation of the reflex phenomena concerned in aural diseases from dental irritation, I shall give some account of the dental disturbances that more particularly affect children.

The *first set of teeth*, which are all cut before the third year, are liable in some children to erupt with difficulty; it is a well known fact that with the cutting of nearly every one of these teeth the ears may be painful or a discharge may occur.

The *permanent teeth* begin to erupt at about the sixth year, and from this time on to the twelfth year, when the process is about completed, the strength of the child is severely tested; during this period of time nature makes an effort to gradually shed the temporary teeth and replace them by the permanent set. When the temporary teeth are shed in the natural way the process occasions but little irritation; but the crowns of these teeth are extremely liable to decay before being shed, when, the nerve being exposed, pains and local irritation are experienced.

The wisdom teeth.—These usually erupt about the eighteenth year. In many instances, however, their appearance is delayed, and they come in with difficulty, causing great aural irritation.

Among the consequences of dental irritation on the ears may be mentioned the increase of wax secreted, the occurrence of boils in the auditory canal, and injurious influences on the drum. The importance of this subject will demand a more particular account of dental disturbances further on.

THE EFFECTS OF GETTING WATER IN THE EARS.

When cold water gains admission to the ears the effect is usually unpleasant, often injurious. Inflammation of the auditory canal, at its delicate inner extremity especially, is a frequent result of getting sea water into this passage. But the drum-head, being yet more delicate, is more liable to become inflamed from this cause. The inflammation seldom is confined to the drum-head, but very soon involves the entire drum cavity.

The force of the waves in *surf bathing* may send the water into the auditory canal with sufficient violence to rupture the drum-head; or, if the wave strikes the bather on the face, water may be thus driven through the mouth and nose into the Eustachian tubes, by which route the drum cavity may be reached. (See Fig. 1, page 7.)

Diving and swimming under water, especially when long continued, are even more dangerous than bathing in the surf; the cold and irritating salt water, when thus long retained in the auditory canal, is very liable to cause inflammation: and should strangling occur, water is then freely admitted into the mouth and nose, the gasping and sneezing efforts to get rid of which are very often sufficiently forcible to send it into the drum. The injuriousness of sea water is owing to its comparatively low temperature and the large quantity of salt that it holds in solution. Prolonged bathing, however, in the waters of brook or pond, is not advisable, neither should the body be exposed to currents of air after coming out of the water. Besides being intensely painful in most instances, these injuries to the ear always cause temporary impairment of hearing; and irreparable deafness, together with chronic discharges, is liable to remain as a permanent legacy. (See page 34.)

The nasal douche.—The use of this apparatus, now unfortunately well established in domestic practice, is exceedingly liable to injure the ears by the transmission of the fluid used to the drum cavity; its employment, therefore, is unadvisable.

Sniffing water or remedies in solution up the nose is not free from the same danger that attends the use of the nasal douche; it should never be practised, therefore, without the advice of some one competent to prescribe the proper mode of procedure.

OTHER CAUSES OF DEAFNESS.

Children's diseases.—Many of the diseases of childhood are well known to leave persistent sequelæ in their wake, not the least offensive of which are aural discharges. Scarlet fever takes the first place in the ranks of these scourges; but measles, diphtheria, cerebro-spinal meningitis, whooping cough, and sometimes mumps are likewise inimical to the hearing sense, their liability to affect the hearing being somewhat in the order of the above enumeration.

Cutting the hair.—Closely cropping the hair of the head, especially its removal from the parts immediately back of the ears, has been observed

to be sometimes followed by inflammation of the organ of hearing. Hair cutting should not, therefore, be thoughtlessly done.

INCAPACITATING DEAFNESS.

Having now given the principal causes of deafness I shall endeavor to define the different degrees of aural disability which incapacitate the pupil, to a greater or less extent, from receiving instruction in the ordinary manner, in order that it may be ascertained what special means of instruction might be necessary. Before proceeding further, however, it would be well to define what constitutes good hearing, in order that we may have some standard from which a departure may be taken.

Normal hearing may be said, then, to consist in the mental perception of sound that has been transmitted through the unimpaired medium of both ears. Without binaural hearing the acquisition of knowledge by the ordinary methods of instruction becomes difficult proportionately to the degree of aural impairment. Hearing with both ears thus enables the pupil to quickly determine the direction from which sound proceeds, and it also enables him to promptly recognize the finer shading in the pronunciation of words. When, therefore, a pupil is observed to be backward in his studies, the teacher should, before attributing his want of success to mental defects, inquire if he hears well. It would be by no means a wise procedure to classify every departure from the normal standard among those who require particular care on account of their defectiveness, for a pupil may progress very fairly in his studies when the hearing of only one ear remains or when he has very considerable defects in both ears; yet such pupils will be very much aided by the recognition of their disabilities.

Incapacitating deafness.—All degrees of deafness may be said to impair the learning capacity of a pupil, but in establishing a standard of impairment which shall consign a pupil to exclusion from his better hearing fellows for instruction, I would select for special methods those who are unable to understand what is said to them in the ordinary tone of voice when five feet away from the speaker. Such a rule, however, must necessarily be applied with discrimination; must be, in other words, a flexible standard, for some defective, but well advanced, pupils, by reason of their natural quickness, will, without being a hindrance, do much better when subjected to the emulative influences of good hearing children. The disposition in the school room of those who have been designated as likely to make better progress under ordinary methods will be considered later on, but for the delicate task of selecting the more defective children from these, I shall now venture to lay down some rules which I trust will serve to aid the teacher until better ones shall have been devised.

METHOD OF TESTING THE HEARING POWER OF PUPILS.

It would be well were it a requirement that the pupils of the public schools should be examined at the beginning of each session with a

view to ascertain what number were too deaf to receive instruction in the ordinary manner and what number, having slight defects, would get on better if seated properly in the school room.

In conducting examinations it will be found that the voice of the person with which the children are familiar in learning is the best test, and, indeed, it is the only sound that need be used; sounds like the ticking of a watch, for example, need not be employed, as the ability to hear them is not significant as regards the pupil's hearing power for sounds used in teaching.[1]

The sentences selected for tests should be intelligible to the understanding of the pupil, and some of the words ought to contain the hissing sounds, others the guttural, as "m," "n," "g," as these are heard with the greatest difficulty when hearing is impaired. Unless the sentences made use of are frequently changed, the pupils may become familiar with some of them and thus comprehend their import without hearing them distinctly.

During the examination the pupil should be placed about twelve feet from the examiner and should close his eyes; an assistant may then stop one of the pupil's ears by the pressure of his finger while the other is being tested. The examiner can now ascertain the hearing power by raising or lowering his voice as required.

In every instance where the sense of hearing is found to be defective, some record of the fact would be found serviceable for future use. It may be well to remark in this connection that the acoustic qualities of the room in which an examination is held should be taken into account—whether it be a large or a small room, whether containing many persons, draperies, &c., or comparatively empty, and, finally, whether any open doors or windows admit sounds from without. The age and the mental development of the pupil are also factors of importance, an uncultivated mind being slow in comprehension.

Examinations of the pupils in the public and parochial schools.—The writer's own observations in private and hospital practice having led him to believe that a large number of children with impaired hearing were in constant attendance at school without due attention being given to the disadvantages under which they were placed, he concluded to institute some examinations of the pupils in the public and parochial schools of New York with the view of ascertaining the percentage of deafness and the state of aural hygiene among them.[2]

[1] The difficulties in the way of establishing a uniform standard for the voice test are well nigh insurmountable, inasmuch as no two persons possess voices of equal quality: it is thought best, therefore, for the teacher of each class to examine his own pupils, employing for this purpose the tone of voice usual in teaching.

[2] The author gladly acknowledges the courtesy and kind assistance in his visitations of the superintendents and teachers in the Roman Catholic parochial and in the colored public schools; his efforts in other departments of the public schools were not so successful, and the absence of encouragement in this direction by those who should be interested will serve to account for the small number examined.

Being aware of the fact that deafness existed in numerous cases where an examination only would convince the patient of the fact, the writer in conducting the school examinations first interrogated both the teachers and the pupils as to their own knowledge of any deafness; their replies and the subsequent lack of verification are significant. It should be stated that these examinations were made under circumstances unfavorable to the attainment of such results as would be required for an exact classification of pupils, for at the visitations the children were found at their recitations or when they were on the eve of dismissal. But the results obtained are thought not to be without value. For his general conclusions on this subject, however, the writer has relied on the thorough examinations made of individual cases which have been brought to him for treatment; in these the tests of the hearing power were made deliberately, and the statements of parents regarding the cases were also obtained.

Remarks on the examinations of pupils in the public and parochial schools.— Five hundred and seventy pupils were examined; they were distributed as follows:

In the colored public schools	261
In the Roman Catholic parochial schools	226
In the white public schools	83
	570

An analytical view of the details of these examinations as exhibited in the tables[1] shows that of the five hundred and seventy pupils examined the teachers were previously aware of the existence of one case of deafness only, while the pupils themselves were but little better informed, only nineteen of the entire number being aware of their aural defects. In my own examinations, which were by no means searching and in which the teachers usually gave the test questions with the intent of compelling the children to hear them, I detected seventy-six cases, or about 13 per cent., of greatly diminished hearing in one or both ears.

Four hundred and eighty-seven of the entire number of the pupils were asked if they had ever experienced *earaches;* one hundred and seventy-three of them, or about 35 per cent., recollected having had this symptom. Among the older children but few had any recollection of ever having had pains in the ears, probably because past pains are soon forgotten. In all of these instances where earaches had been experienced it may be inferred that the aural affection that gave rise to them had also more or less permanently damaged the sense of hearing; but such defects would not be apparent unless more delicate tests were made.

ANOMALIES OF HEARING.

There are some peculiarities in hearing experienced when the ears have never been diseased which cannot be strictly included in any of

[1] The details of these examinations may be consulted in the tables appended at the end of the paper.

the subjects previously considered; among these is the ability of some individuals to hear most acutely certain sounds while they hear others very badly: thus, a person may hear the low rumbling of the thunder attending sheet lightning, a sound quite inaudible to many, while the chirping of a cricket, which is painfully acute to some, he will not hear at all. I have no doubt that experiences quite the contrary of this may exist, but as yet I have been unable to confirm the opinion by observation; in certain diseased conditions of the ear, however, examples are not wanting where persons hear the ticking of a watch, which is a high sound, quite well, but who hear conversation in a low tone of voice with difficulty. On the other hand, the relatively good hearing for low sounds of the voice is sometimes a condition in aural affections.[1]

Autophony.[2]—Autophony occurs during the progress of most aural diseases. It consists in hearing one's own voice in the head; it sometimes amounts to simply this, but there is often heard a reverberation of the voice, or an "echo" as it is often styled, and it is then described by the sufferer as double hearing. When the patient thus hears his own voice he fancies that others cannot hear him talk, for the voice seems to go up into the affected ear instead of going out of the mouth. The effort of talking becomes very tiresome to him, for no exertion, however great, is of any avail; the louder he tries to speak the more disagreeable his voice sounds in his own ear.

The autophonous voice sounds very strange to the patient; it is unlike his own voice; it seems as though another person, at a distance, were speaking. When the voice is thus heard false by the pupil, he is unable to regulate or control it, for at one moment it may sound quite naturally, as though in fact it came out of his mouth and went around to the ear as usual, while the next moment it seems to fail of utterance altogether and reaches the ear from within the head.

In false hearing the voice usually appears to be hoarse, the patient often calling one's attention to this with the remark that he must have caught cold. Sometimes the voice, however, seems to the sufferer to be very high in pitch. When hearing it higher than it should be, the patient makes an unsuccessful effort to correct the fault by lowering his voice, often to a whisper; when it seems "hoarse" and low the attempt to correct the apparent defect results in an unpleasantly loud voice.[3] During the continuance of this trouble confusing noises in the head are also experienced; they are but little less annoying than false hearing. This symptom is often of brief duration, but in a large number of cases it becomes permanent.[4]

[1] The number of persons who (without aural disease) possess these peculiarities is comparatively few, as far as is known, but as attention is directed to these conditions it is probable that the number will be found to be considerable.

[2] See note at the foot of page 11.

[3] This will explain why some deaf people shout their words to those whom they know to have good hearing.

[4] Allusion has not been made to the effect of false hearing on those who use the singing voice; it may be said that while the hearing is thus affected the voice cannot be

The autophonous voice sounds so alarmingly to children that they frequently avoid speaking altogether; when silence is thus maintained the child is called "dumb." It has been my experience to have many patients of this kind brought to the infirmary by their parents, and it has not infrequently come out at the examination that such patients have been severely punished for supposed stupidity. This condition of the hearing organ is by no means of infrequent occurrence, and the teacher should consider its possible influence on a child's behavior before condemning it as perverse or wilfully disobedient.

Noises in the head are almost inseparable from all kinds of aural affections; they manifest themselves in an infinite variety of phases, almost every patient describing his own experience differently; they are thus said to resemble ringing of bells, the roar of the sea or of the wind among the trees, the buzzing of insects, the escape of steam, &c. To some these noises seem so loud that rest cannot be obtained. They must be very confusing to children who experience them in some degree with almost every cold in the head, and where long neglected running from the ear exists the distress from tinnitus must often be very great indeed.

The above by no means presents in their strongest light the troubles that children experience when the sense of hearing is perverted; it may, however, serve to show that they are subject to some very distressing symptoms without always being able to make their sufferings known, such facts, in my own experience, only being elicited from the uninformed and apprehensive patient by the most painstaking examination.

IMPERFECTIONS IN SPEECH.

Attention will now be given to another kind of difficulty—in its way no less vexatious than the disabling affections already mentioned—an ailment existing very often altogether independently of aural disease yet having its origin in the same etiological causes: I allude to anomalies of vocalization. Although these anomalies usually coexist with defects in hearing, their differentiation is important in the management of backward children, for the subject may otherwise be relegated to the class of feeble-minded youth who are considered as but little removed from the demented.

The acquisition of language may be said to consist in correctly hearing the words and sentences of which language is composed and in the persistent repetition of the same until memorized. Children, therefore, require good ears and long practice in the imitation of the voice of their instructors before they become masters of spoken language. It should be kept in mind here that a slight degree of deafness may be sufficient to hinder the child in the first steps that he takes in learning to talk—and these first steps are, probably, much more immature than they are

trained to singing, nor can the pupil so affected be taught to perform on musical instruments. For an account of false hearing, in this connection, see the author's paper "On false hearing and autophony in singers, speakers, and performers on certain musical instruments," in the New York Medical Record, January 22, 1881.

usually thought to be, as the infant is at first, probably, unconscious of most sounds, the perceptive faculties of the ear not being taxed beyond the requirements of the mental faculties.

It is very difficult to discover defectiveness in hearing before the child is one year old; owing to this fact the child may be "stone deaf" for a considerable time before the discovery is made. Even a slight defect in hearing is a detriment to the infant, for his education begins as soon as the slightest attention to sound is given.

The child, in this process of acquiring knowledge, repeats words as they are heard; if it hears them incorrectly a faulty enunciation is acquired; thus every one has observed in his own experience how unintelligible the language of partially deaf children is, how slow they are in learning to talk. The flexibility of the voice is naturally very great, and uninterrupted practice increases its fluency from day to day; the young learner, relying on his imitative faculties rather than his own judgment, readily adopts the accent of his teachers and associates, and in this manner he acquires the dialect of the locality in which he lives.

The correct enunciation of words depends very much on a healthy condition of the upper vocal organs—the mouth, nose, and pharynx—and on the unobstructed passage of air through them during vocalization. Repeated attacks of head colds, resulting in nasal catarrh, enlargement of the tonsils, &c., together with irregularities of the teeth, are the principal etiological factors in the development of impediments that interfere with the physiological functions of these parts. A nasal tone of voice is an almost invariable characteristic of these impediments, but very often the obstructions in the throat or nose are so great as to give a "choked" expression to the voice. Enunciation then is difficult; for example, letters which require for their pronunciation the use of some of these parts, as "m" and "n," cannot be correctly enunciated. When defects in speech arise from disease in both the ear and throat the pupil is placed at a very great disadvantage indeed as regards the learning of correct enunciation; he fails to hear certain words and on the other hand there are certain others which he is unable to enunciate. Thus, the hissing sound of the voice may not be heard at all; the pupil is therefore liable to leave it out of his speech entirely; for example, he will pronounce sir as "thir" and sausage as "thausig," and so on. Should the deafness be very great, the person will omit such sounds entirely, not that he is physically unable to make them, but he does not know how they sound. Now, should the pupil possess obstructions in the nose and throat as well as defective hearing, instruction under existing methods will be difficult—in some instances well nigh impossible.

The voice, it should be stated in this connection, becomes very much modified after the individual ceases to hear well: it loses its flexibility and can no longer be modulated.

MANAGEMENT OF PUPILS WITH IMPAIRED HEARING.

The *separate education* of pupils whose impaired sense of hearing debars them from the benefits of education by ordinary methods, from the investigation that has been made concerning their capacity to acquire knowledge, would seem to be a necessity. The claims of the deaf-mute have been long since recognized, and his wants in great measure provided for; it remains now to recommend measures for a neglected class of equal numbers whose requirements are no less urgent.

I shall not, in this connection, essay to suggest any matured scheme for the special instruction of those who are not entirely beyond the reach of vocal methods, but who are yet too deaf to be taught with good hearing pupils without interfering with their instruction: the attempt would carry me beyond the scope of this paper. Such a scheme will require for its successful development the time and labor of experienced teachers, and even under the most favorable circumstances the progress of any plan will necessarily be slow. I shall, however, venture to offer some suggestions in the matter, hoping that, inasmuch as my views have been derived from a very considerable experience in the observation of aural defects, the advice given from an otologist's standpoint may not be without value.

We will suppose that steps have been already taken to ascertain the hearing power of the pupils; the next step will be the classification of such as have been found to be defective.

Disposition of deaf pupils.—Any pupil found to hear the ordinary voice of the teacher with difficulty should occupy a seat near him.

When hearing is good in one ear only, the child will hear to the best advantage if seated rather to one side, so that the good ear will be toward the teacher.

Pupils whose defective sense of hearing prevents them from receiving scarcely any instruction by the usual vocal method should be, if possible, separated from the good hearing and taught by special methods. As intimated before, children who cannot understand the teacher at the distance of five feet, when addressed in the ordinary tone of voice, are not only an obstruction to the work of teaching other pupils, but they can learn but little themselves. These pupils, in many instances, may perhaps remain very deaf only a short time; they may be entirely cured by treatment; special instruction would then, in these cases, be regarded as tentative only, for when improvement takes place their advancement will be more rapid among pupils whose hearing is good.

When it is found that children are too deaf to make any progress or from an increase of deafness it is unmistakably manifest that they cannot be instructed by vocal methods, they may be relegated to a department where deaf-mutes alone are taught.

Deaf-mutes.—When the acoustic organs are too greatly impaired for vocal instruction to be of any benefit, pupils are generally designated as deaf-mutes. This classification, however, is rather an arbitrary one, for

all persons who are unable to understand speech by means of the sense of hearing are by no means mutes, nor can all of them be instructed equally well. It would be well, therefore, for the purposes of instruction, to divide this class of persons into two groups: those who hear their own voice and those who do not.

Of the first named group it may be said that a certain number are congenitally defective, while others become deaf at a later period in childhood. Notwithstanding the profound deafness of these children to outward sounds, some of them are capable of learning to speak with greater or less distinctness, the perceptive functions of hearing having been preserved to a goodly extent while the transmitting mechanism has sustained irreparable impairment. To the greater number of these pupils the autophonous voice which remains to them is very far from imparting a natural impression of the voice to the mind; their vocalization is notable for its "muted" cadence, the words seeming to be uttered in imitation of the sounds transmitted to the perverted sense of hearing from their own vocal organs. A much better vocal power remains when children have previously learned to talk well than when speech has not been so acquired. Under no circumstances, however, will the voice remain unchanged; it is no longer flexible and pleasantly modulated, but soon becomes mechanical and harsh.

The second group of deaf-mutes includes those in whom there is an entire absence of the perceptive function of hearing, either congenitally or from the more severe diseases which deprive the auditory nerve of its functions. In some of these the transmitting mechanism of the middle ear may not be greatly impaired, but the nerve no longer perceives sensations of sound from any source, either without or within the head.

Of these, the congenitally deaf can never, I am inclined to believe, practicably be taught to speak very intelligibly, for they cannot hear any sound upon which the mind may form an idea as to the character of speech. They, however, who have once fairly acquired speech may retain the use of it in a very satisfactory degree after becoming deaf, if well trained. Very young children who have only just learned to talk soon lose the faculty, and it is very difficult for them to ever learn to speak well again.

In a certain number of cases of deaf-mutism both the middle and inner ear are undoubtedly affected by disease, but in the greater number of cases the disability seems to be mainly seated in one of these regions only. Where the functions of the nerve of audition have not been exercised, in consequence of early impairment of the mechanism on which transmission of sound to the inner ear depends, its deterioration will probably ensue. Owing to the neglect of a great many of these children at home, the difficulties in the way of their education are much increased. Although the number of pupils who will be found to hear their own voice fairly well is comparatively small, yet it would be well to differentiate between these and the pupils who do not, for the former possess capa-

bilities for learning which the latter do not enjoy; the one may acquire articulate speech, while the other may be advantageously taught the sign language only.

These children, in the larger cities, could in many instances be more economically taught if kept under home influences and educated in a special department of the public schools.

In the instruction of the very deaf and of those who hear no external sounds but yet hear their own voices, some assistance may be obtained by the employment of conversation tubes among the former and of the mouth trumpet and otacoustic fan among the latter. The mouth trumpet, which consists of a tube for speaking into the mouth, gives the pupil in some instances a more correct idea of the natural tone of the voice than any other aid to hearing. Dental sound transmission by means of a fan can also be made serviceable in certain cases, the speaker being obliged, however, in availing himself of its use, to place the pupil within one or two feet of his mouth while thus teaching. The use of these appliances, moreover, will aid the examiner in determining the pupil's hearing power for his (the pupil's) own voice.

It is hoped by the writer that what has been said above concerning the education of deaf-mutes may not be construed to reflect upon the usefulness of institutions that are more particularly asylums for the physical care of this class, and which not only provide temporarily a charitable home for them, but also give them an education at the same time.

DEAFNESS AMONG TEACHERS.

It is not unfair to state that teachers do not enjoy greater immunities from impairments of the sense of hearing than others in the same social position; and, although a certain degree of deafness should not exclude a person otherwise competent from the pedagogical profession, yet it must be confessed that good hearing is very essential to one who has so many experiences to try his temper and who should be able to avoid doing an injustice to any pupil from a failure to hear everything that is said in his presence. Should an instructor himself be defective in his hearing sense and yet be unaware of the fact, it would be easy for him to unjustly censure children for incompetency in the course of instruction or in examinations for promotion simply because their responses were not heard. The writer has known instances where teachers when suffering from temporary deafness were almost sure to hear certain words incorrectly, and were therefore obliged to ask pupils to repeat their replies over and over again before they could assure themselves of their correctness. Such experiences are a warning to those having irremediable defects.

Persons desirous of acquiring a pedagogical education at the public expense should be subjected to an aural examination before they are accepted; and in the appointment of teachers in the public schools the ability to hear well should be a requisite. If the examinations were al-

ways oral, the applicants being required to *hear* the questions, they would be more satisfactory than if otherwise conducted. I have in mind an illustrative case which is of interest in this connection: A young lady nineteen years old had been, it was supposed, thoroughly prepared for teaching in an excellent school for young ladies; but, owing principally to dental irritation, she gradually became so deaf that when, after graduation, she appeared before a Brooklyn board of examiners for appointment as a teacher in the public schools, she utterly failed. The questions were given out orally, and she was unable to answer them because of her inability to hear them correctly. The board of examiners, however, was not aware of her aural defect. Had the same attention been given in the case of this young lady to the condition of the ears and teeth that was devoted to her mental improvement, her success would probably have been assured. When I saw her shortly after her failure it was found that her mouth was greatly deformed by irregular teeth, and that these, together with a great amount of dental caries, had been the principal cause of the deafness; the teeth had never received any attention, and from the irritation attributable to them and her inability to properly masticate her food the general health had also suffered.

AURAL HYGIENE IN THE SCHOOLS.

That we have a faulty system of school hygiene no one familiar with the facts will deny; and the remark is equally true both as regards the construction of our public school-houses and the personal care of school children.

When we are appealed to as humanitarians to provide hospital accommodations for the pauper class, no means are spared in the planning and erection of healthful buildings for their use, but when school-houses are to be constructed — where both body and mind should be aided in development, prepared, I may say, to enter the struggle for "the survival of the fittest"—their erection is, I fear, too often intrusted to the political contractor, whose knowledge in building is chiefly confined to "making it pay."

Let us hope, however, that time will correct these abuses, and in the mean time we must discuss what is best to be done with such buildings as have been given to us. These are not, perhaps, so faulty but that better hygienic regulations could contribute very much to their comfort and healthfulness.

It will, however, be useless to devise plans for the heating and ventilation of school-houses so long as negligence and apathy prevail on the part of those who have such matters in charge; these seem to regard the heating of apartments occupied by school children as contributing sufficiently to their personal well-being. It is, no doubt, honestly believed by many to be more important to maintain a certain established temperature in the school room than to protect the individual from injudicious exposures to draughts or to an undue elevation of temperature, as

the case may be. There has been so much said about the ills that arise from breathing foul gas and dust, which are believed to poison the blood or irritate the air passages, and so little said about the dangers of draughts of air, that the latter are liable to be overlooked in the anxiety to avoid the evils attendant on the former. Too much care cannot be taken, obviously, to avoid the inhalation of deleterious matters, but certainly equal care should be exercised to guard against the injurious effects of air draughts to which pupils are so much exposed. It would be of much service in properly ventilating school rooms were open fireplaces in more general use, and it is to be hoped that architects and sanitary engineers will insist on the introduction of these in the future. It may be well to say a word here as to the proper temperature of school rooms and the clothing of the pupils.

Temperature of the school room.—The temperature of the school room should be kept at about 68° or 70° Fahrenheit, as indicated by the thermometer; it should not be regulated by the sensitiveness of any individual, such a test being by no means reliable for this purpose. The necessity for the renewal of fresh air for ventilating purposes must be determined by the season of the year, the size of the room, and the number of pupils present; when the doors and windows are thrown open for this purpose, the children should be required to leave their seats and walk about in order to avoid any ill effects from draughts. Children should be protected, if possible, from exposure to currents of air after exercising; nor should they stand or sit while "cooling off," but move about quietly and resume any wraps that have been laid aside. The air of halls or lecture rooms, especially when illuminated or crowded, soon becomes much vitiated, and, by depriving the system of its natural powers of resistance, favors the invasion of colds

Insufficient clothing.—A large number of children present themselves at our public schools insufficiently clad, or come during inclement weather chilled from exposure; they are often obliged to sit in wet clothing, especially wet stockings and shoes. The parents of the poorer pupils will require their attendance at school under the most unfavorable conditions, that they may be for a time relieved of their care. To neglect the physical condition of this class would seem no less a culpable oversight than a disregard of intellectual training.

The excessively clad.—As regards another and entirely opposite class to the above, a greatly increased sensibility ensues from the use of too much clothing and the neglect of outdoor exercise; thus, children are often made exceedingly susceptible to colds by the use of superabundant wraps made of furs, which, in our climate, are at best suitable only for emergencies arising in exceptionably cold weather. It is a well known fact that among the more wealthy the constant use of seal skin sacks and all kinds of fur collars, boas, &c., is the cause of unmanageable head colds; such colds, when unrelieved, are the means of establishing most persistent nasal catarrhs.

From what has been said above, it will be seen that our system of school hygienics is by no means perfect, and we may infer that the home sanitation of children is also deplorably faulty; when these shall have been corrected, much physical suffering will be prevented and many of the complaints under consideration avoided.

We have now to consider the consequences of these neglects on the acoustic organs, among the most important of which is taking cold in the head; to this is to be attributed a large proportion of children's aural affections, and I shall, therefore, discuss the etiological factors concerned somewhat at length.

TAKING COLD IN THE HEAD.

Taking cold is an experience usually derived from unguarded exposures to draughts of cold air. When the weather moderates, colds are observed to be especially prevalent; the care ordinarily exercised for the body's protection is then neglected: warm wraps are laid aside, wet clothing is permitted to remain upon the person; and then, too, it is that rooms are liable to become overheated, and the dangerous draughts which are created by negligently leaving doors and windows open are not avoided with sufficient care. It is a well known fact that colds are not most prevalent in the coldest weather, but that, on the contrary, the persistently low temperature of our northerly climate is most invigorating; indeed, while the extreme cold holds on, catarrhs are conspicuous by their absence. It is worthy of mention, in confirmation of the above, that the inhabitants of our South Atlantic and Gulf States by no means enjoy an entire immunity from colds and their consequences. Although their winters are exceedingly mild, the thermal vicissitudes are even more trying than at the North, and catarrhal troubles are therefore not unusual.

The modus operandi of taking cold having been already explained (see pages 13–14), it now remains to account for the prevalence of catarrhal affections among school children, in order that hygienic measures may be inaugurated for their prevention. It has been asserted above that nervous sympathetic action, whereby widely separated parts are brought into intimate relationship with each other, is to be dreaded because of its insidiousness; thus, following an exposure whereby a cold in the head is established, the irritation in the nasal region is not, as may be supposed, owing to the cold air inhaled, but to the reflex action of the nerves. A supposititious but exceedingly familiar example will serve to illustrate this proposition: A current of cold air—it may only be comparatively cold, from the cooling effect it has by hastening evaporation of the moisture upon the skin—is wafted in through an open window and allowed to fan the head and shoulders of a child who has become heated by the exercise of play or in hurrying to school; the exposed parts, the head and shoulders in this instance, receive a shock the local effect of which is usually slight, but through the agency of the sympathetic

nerves a more decided impression is made upon the mucous membrane of the nose. This may be announced by an attack of sneezing, more or less violent. Wet feet and clothing are also prolific sources of colds, both in the head and elsewhere.

Slight colds in the head are even more serious in their consequences than the effects of severe attacks with long intervals of immunity. When fresh attacks are almost daily experienced, the patient is for the most part absolutely indifferent because profoundly ignorant of any danger. Frequent recurrences, moreover, seem to eventually establish a susceptibility to these invasions, and when, finally, a chronic nasal catarrh is established the parents are greatly surprised to learn that, although complaints may have been confined to the state of the hearing organs, a most intractable nasal affection has been established. Nasal catarrh is sometimes an affection of the very earliest period in life, some infants, in fact, having evidences of it at birth. The affection is nearly always to be recognized by the flow of mucus from the nose, which gives rise to constant snuffling, and sometimes excoriates the nostrils and the upper lip; in older children attempts are made to hawk the secretion up into the mouth, as it otherwise has a tendency to drop down into the throat, where its presence causes irritation.

The general health of these sufferers is, of course, always more or less affected, for no organ of the body can be considered entirely independent of the others. Owing to the immediate connection through the Eustachian tubes, which are lined with mucous membrane which is continuous with that of the nose and pharynx, and also by means of the intimate nervous relationship, no organ probably suffers more from the consequences of colds in the head than the ear. Although these sufferers may have aches and pains in every region of the head, the importance of which the writer would by no means wish to exclude from due attention, yet he believes that the aural aspect of the subject is of sufficient consequence to justify him in drawing the attention of teachers especially to it, and, although they may not entirely prevent the occurrence of the colds which thoughtless pupils subject themselves to by exposures, yet they can do much in this direction with the means at their command, if not unmindful of their share of the responsibilities devolving on all of us who assume to aid in the work of bringing forward the youth of our race. (See page 13.)

DENTAL IRRITATION AND THE CARE OF THE TEETH.[1]

The irritation of decayed teeth or inflamed gums is not only a frequent cause of aural disease of an acute nature, but very often it happens that when the ear is in a moderate state of irritation from sympathy with the teeth a cold or other cause will be much more liable to set up acute aural inflammation. From the present writer's own experience for some years he believes that diseases of the ear arising from

[1] The author is indebted to Dr. Frank Abbott, of New York, an authority in dental surgery, for valuable suggestions on this subject.

affections of the teeth are more frequent than has been urged by writers on the subject;[1] he feels, therefore, that the very considerable space which he shall devote to the matter will not be greater than its importance demands.

The teeth of some infants require very early the physician's and dentist's care, their eruption and development being so unhealthy that by much care only can trouble be obviated.

The *temporary teeth*, then, will first demand attention. The popular belief is that it is of no consequence when these teeth decay or are extracted, inasmuch as the permanent set will soon restore the loss. The evils resulting from the neglect that is based on this fallacy are very great. The temporary teeth, aside from their usefulness in the mastication of food, are the necessary pioneers of the second or permanent set; they should, therefore, be carefully preserved, not only from the injury likely to ensue from biting very hard substances, such as nuts and the like, but also from the deleterious influences of uncleanliness. If the decay in a temporary tooth is not treated and then filled properly before the nerve pulp is destroyed, the roots are not absorbed as they should be and hence they are in the way of the coming permanent teeth and divert them from their proper course; in most instances there is also much irritation from the crowding that ensues (see 1, 1, Figure 7, page 32). Sometimes these temporary teeth, with their unabsorbed fangs, are crowded partly out by the permanent teeth, but remain in the gum by the sides of the new teeth; should their fangs be sharp, much irritation is caused by wounds of the cheeks or tongue, and their presence in the gum is a sufficient source of irritation to set up aural hyperæmia.

The regularity and healthfulness of the permanent teeth depend very much on the treatment of the first set; especially is the much too general practice of extracting the temporary teeth, because they are believed to be of little service, to be deprecated. Just here a word of caution is required concerning the appearance of the first teeth of the permanent set, namely, the six-year molars.

The *six-year or first molar teeth* are four in number. These teeth, on account of their imperfect state, are believed to be less able to withstand the influences that lead to caries than those of the permanent set which are cut later, and they are, therefore, liable to decay early. Even when parents find them decayed they are generally neglected, although sometimes exceedingly painful, for they are usually supposed to be temporary teeth, and hence not worth preservation. They should, if possible, be preserved. Another dental epoch sometimes has an importance to the aurist on account of the great amount of irritation that may exist without the cause being suspected. I allude to the eruption of the third molar or wisdom teeth.

The wisdom teeth.—These teeth should erupt at about the eighteenth

[1] Dr. Charles H. Burnett was among the first to call attention to the nervous connection between the teeth and the ears. Treatise on the Ear, Philadelphia, 1877.

year, but they often come at a much later period and erupt with great difficulty. They are especially liable, in the lower jaw, to push against the adjacent tooth, and, being urged onward in the process of erupting, cause very great irritation. Some of the most intractable affections of the ear become established in this manner before the cause has been discovered.

I have long been in the habit of examining the teeth of children brought to me with aural diseases, and it happens very often that unsuspected dental irritation is found to coexist, to which the aural irritation is in some measure attributable. Among the large number of cases of school children who attend the aural clinics at the infirmary it is rare to find one where dental irritation should not be considered as a causative factor.

FIGURE 6.—Lower jaw or interior maxilla, from a specimen in the author's cabinet. The figure shows the horizontal position of the lower wisdom teeth, the position which gives rise to their difficult eruption. 1. The right wisdom tooth, which is wedged in between the ramus, or upright portion of the jaw, and the second molar tooth; it has not, as yet, been able to leave its socket and cut through the gum. As the tooth is urged onward in the effort to erupt, it is forced against the sensitive root of the neighboring tooth, the pressure giving rise to much irritation. 2. The fully erupted left wisdom tooth; it is inclined toward the first molar; the second molar on this side having been lost, room was afforded this tooth to cut through the gum.

The teeth of children should be frequently examined at home, and any suspicious spots should not be neglected. It is a noteworthy fact that during the period of active dentition the nervousness of children is marked and the susceptibility to reflex phenomena is increased.

The disturbance caused by these teeth is sometimes very great; the parts are not only subject to great swelling, but the suffering is often of a severe character. When mastication is attempted, the gum over the tooth is liable to be bruised and thus increase the irritation. Sometimes the irritation goes on for years, until nature seems to exhaust her expulsive forces, without completing the process of eruption; pains may or may not be experienced, sometimes they seem to shoot from the tooth to the ear. Through nervous sympathy the ears are very often affected. The two upper wisdom teeth usually erupt a short interval after the two lower and are cut with less difficulty.

Disease of the teeth in the schools.—My attention, as above stated, having been drawn to the frequency of dental caries in connection with aural affections, I was led to make a thorough examination of the teeth of a considerable number of pupils in actual attendance at a public school in order to obtain a knowledge of their exact condition.[1] The number of such pupils examined was eighty; they consisted of such children as happened to be present in a number of class rooms, the attendance being small, as is usual in midsummer. It was found that scarcely any of the children were free from dental irritation, and few of them had teeth in a normal condition. In thirty of the number the teeth were in such

[1] These children were nearly all of German parentage.

an unhealthy state, from irregularities and decay, that wax impressions were taken of them; these have since been mounted up in plaster for study. The deplorable neglect of the teeth among these children was a surprise to me, although, from previous observations, I had expected to find them very bad indeed. It was notable that teachers having charge of these pupils never suspected that the teeth ever gave rise to any serious trouble, but it was ascertained by questioning the children themselves that in nearly every instance they had experienced pains in the teeth or ears, sometimes in both. The appearance of many of these children indicated that the general health had not escaped the consequences of imperfectly masticated food; that some of them also suffered from neuralgias about the face and head "goes without saying."

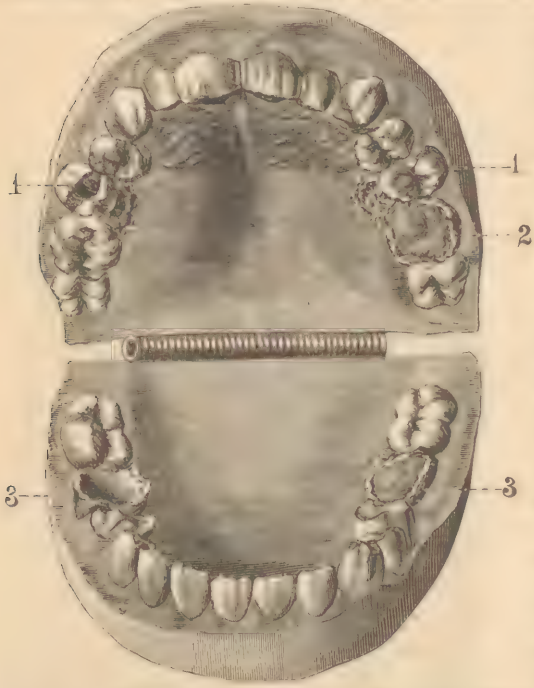

FIGURE 7.—Casts of the teeth of a school girl twelve years of age; from the author's cabinet; the casts are represented as being held together by a hinge. 1. 1. The second bicuspid teeth of the upper jaw, both of which have been crowded out of place as they erupted by the remains of the fangs of the temporary second molar teeth; these fangs, which have been too long retained in the gums, are seen in the cut just inside the second bicuspids. The retention of the fangs, together with the crowded and irregular condition of the permanent teeth which have just been cut, gave rise to much irritation. This anomalous condition of the teeth is by no means an unusual occurrence where the teeth are neglected. 2. The left upper six-year molar tooth, which is very carious. 3, 3. The two lower six-year molars, both of which have been destroyed by caries. The little girl from whose teeth these casts were taken suffered from deafness and frequent attacks of pain in both ears, and, as she herself expressed it, "the decayed teeth had ached very much all around."

The casts of the upper and lower teeth, shown in the cut (Fig. 7), represent one of the cases seen; it is by no means an exceptionally unfavorable example.

The cast shown in Figure 8 represents another case. This person always had trouble with his teeth; they ached severely in childhood while he was at school, and he has had brief periods of immunity only since that time. His teeth were in so bad a state that mastication of food was well nigh impossible, for the pulps were exposed in nearly every one of them and the pressure of solid food on the pulps gave rise to so much pain that the food was bolted down hastily. The dental nervous filaments being in a state of constant irritation, not only gave rise to neuralgias of the head, but the whole system also sympathized. The food was retained about the jagged remains of the teeth, and, becoming decomposed, was taken into the stomach along with the purulent matter from the diseased gums; thus, contaminated by the

secretions of the mouth and imperfectly masticated, it caused an aggravated form of dyspepsia before the patient was sixteen years old. This person, when he came to the New York Eye and Ear Infirmary, where he was first seen, was found to be very deaf in both ears, and the right one was the seat of a very painful inflammatory affection; he complained of being very weak, and his appearance was that of a person who had become prematurely old. His face was pale, the cheeks having dirty-brown patches, from which the outer coating of the skin could easily be rubbed off. His eyes were weak, and a discharge from them had to be constantly wiped away. In regard to the teeth in this case it may be said that the patient never knew what it was to possess the use of them in a normal condition, for all of the back teeth of the second set probably came into the mouth in an imperfect state (deficient in enamel) and were therefore easily destroyed by disease, while the front teeth decayed from neglect to keep them clean.

FIGURE 8.—View of plaster casts of the upper and lower teeth (Cabinet No. 14) of a youth aged twenty-two years.

In Figure 9 are represented the teeth of a boy who was born and brought up in England, where such deformities are, I believe, more frequent than on this side of the water. This person came to the New York Eye and Ear Infirmary in 1880 on account of his deafness, which had been very great in both ears ever since he was eleven years old; he can hear the voice only when spoken in a loud tone, which makes it difficult for him to perform his duties as cabin boy on board ship. The ears never ran, but he began to acquire his deafness during the period of his schoolboy days, at which time he experienced much toothache, and he still suffers from the pains occasioned by the decay of the second teeth. His tonsils are greatly enlarged, which, together with deformity of the teeth, preventing

closure of the mouth, has been the cause of habitual mouth breathing: such breathing prevents the normal development of the ear from taking place, and the irritation produced by the crowded and diseased teeth gives rise to aural inflammation.

It will be seen, by referring to the cut, that a very extraordinary deformity exists, namely, the articulation of the teeth is reversed, the under teeth shutting outside of the upper teeth all around the jaw. This state of things has been caused, it may be surmised, by neglect of the temporary teeth of the upper jaw and their premature removal, thus causing contraction of the superior maxillary arch. When the permanent teeth came into the mouth, the upper jaw being too small to allow them to take their regular position, they were crowded and consequently irregular. When food is retained about irregular teeth their decay is almost inevitable, and in the case before us such neglect seems to have caused early decay of the first permanent molar teeth, which were accordingly extracted; their loss occasioned a contraction of the superior maxillary arch to the extent of at least one inch.

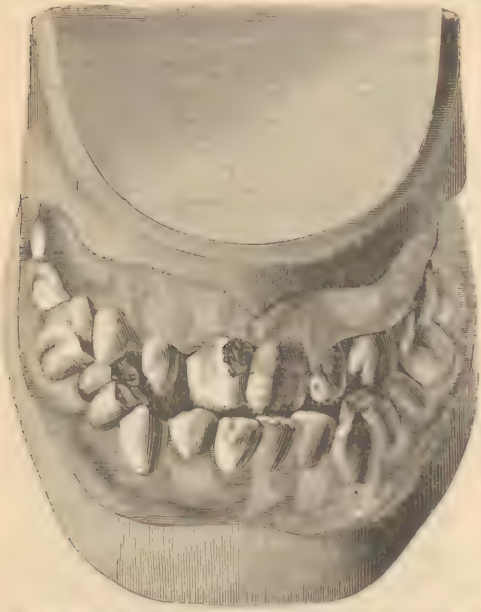

FIGURE 9.—Front view of plaster casts representing the teeth of a boy aged seventeen (Cabinet No. 61).

The lower teeth not having suffered in a similar manner to the upper, the inferior maxillary bone has gained its normal size, and the lower teeth, in consequence, close *outside* of the upper (Fig. 9). Of course the teeth have caused irritation in this case from a very early period in the person's life, and their condition has likewise interfered with mastication. The deformity of the face in these cases is very great.[1]

Dental inspection.— Neglect of the teeth among the children of the poor can only be prevented by some system of inspection. Among the well-to-do advice only can be given, but in the public schools arrangements could be made to secure competent assistance from the dental departments of some of the charitable institutions. In places where such institutions do not exist the services of some competent dentist could be obtained. (See page 29.)

[1] The author desires to acknowledge his indebtedness to J. M. Stebbins, D. D. S., of New York, for his valuable services in this investigation, and particularly for the impressions of the teeth. To his skill in the treatment of such cases many of the children were afterwards indebted for relief.

OUTDOOR BATHING AND ITS EFFECTS ON THE EAR.

Bathing in the ocean, rivers, and ponds is a summer pastime to which children are very much addicted; it is generally regarded as harmless, provided drowning does not take place. If any cautionary measures are thought to be worth while they are usually embraced in two sentences: "Be sure first to wet the head" and "Be careful not to get drowned." This advice to immerse the head immediately on entering the water is certainly not wise and the other caution may be regarded as an unnecessary expenditure of parental concern. Although the exercise of swimming and the self reliance learned from taking care of one's self unassisted in the water have their advantages, yet the evils arising from a too prolonged stay in the water certainly more than counterbalance the possible good that may accrue. From a strictly sanitary point of view it may be doubted if, upon the whole, the loss is not greater than the gain, for children will not exercise any judgment in such matters. Supervision of bathers is not always practicable, but parents and teachers may impart some serviceable advice, which, if followed, may be the means of preventing injury to the ear, which is more liable to injury from the direct effect of the water in bathing than any other organ of the body. Marine animals possessing delicate acoustic organs have them protected from the water by the provision of nature; they are able, in fact, to close up the passages leading to the ears when they are submerged. Man, however, being in no sense a marine animal, has not been provided with self protecting ears; he must, therefore, guard against the entrance of water by devices of his own, which can be at best only partially successful. He may thus in a measure keep the water out of the auditory canal by closing it with pellets of wool, that obtained from the sheep being preferable to cotton on account of its non-absorbent qualities. The excluding of water from the mouth and nose in the surf, or when swimming or diving, is not so easily accomplished, depending as it does on an effort of the will. Holding the nose or plugging its anterior openings is impracticable in most instances.

I have seen many cases of severe aural disease among children—the milder ones are probably neglected—from the use of the New York public baths. Owing to the negligence of some of the superintendents of these establishments, aural disease is frequently contracted by the bathers. Although children are not permitted to remain more than a few minutes in the water, yet they manage, by making the most of the time at their disposal, by diving and struggling in the cold salt water, to get enough of it in their ears to injure the organ more or less.

Those who bathe very much are liable to suffer from slight injuries to the ears from time to time, and, inasmuch as pains are not always present, no trouble is suspected until very considerable impairment of hearing occurs. The exposure of the body on coming out of the water to the gradual drying influences of the wind is, of course, to be avoided. (See page 16.)

MOUTH BREATHING.

A noticeable practice among some school children is that of habitually breathing through the open mouth, a custom that has been regarded as a consequence of defective hearing; but the reverse of this is true; such breathing arises from obstructions of the nasal passages, irregular teeth, enlarged tonsils, &c., and in many instances the habit is acquired where no physical cause is known to exist. Habitual mouth breathing prevents the normal renewal of air in the drum from taking place.

Deformity of the drum-head is a consequence of the absence of the proper amount of air in the drum during the period of its development. The sound transmitting mechanism is crippled by this deformity, and the sense of hearing is correspondingly impaired.

When no physical necessity for this practice exists, its continuance should be discouraged; breathing should take place through the nose, nature having provided this organ with warming cavernous departments which temper the air before it enters the lungs. The great influence that irregularities of the teeth have on mouth breathing is believed to be of sufficient importance to warrant the introduction of a cut (Figure 9, page 34) which represents the case of a lad who became exceedingly deaf from this cause. Every one must have observed the hideous facial expression of persons whose ill developed jaws, irregular and projecting teeth, prevent closure of the mouth.

WHAT TO DO WHEN FOREIGN BODIES GET INTO THE EXTERNAL AUDITORY CANAL.

Foreign bodies in the external auditory canal are not always an inconvenience, nor do they always cause deafness, but when their presence in this situation is discovered efforts for their removal are usually undertaken with an energy proportionate to the alarm of the child's friends, and, when their own efforts have been unavailing, the assistance of some convenient druggist or barber is obtained; these only too often succeed in pushing the offending substance farther in, and then the unskilful work may be carried still further by some bungling pretender, who soon causes irreparable injury to the hearing organ by his more ambitious attempts. Such treatment by incompetent persons at best only results in pushing the foreign body farther into the passage, where its presence against the drum-head may do much harm. Even death is reported to have followed the fruitless probing and tearing of a child's ear, when no foreign body was present. It is a safe rule, therefore, to let foreign bodies alone unless competent aid can be obtained. (See page 12.)

Live insects sometimes gain an entrance into the auditory canal, where their movements give rise to much distress, especially if the drum-head is reached by them; their expulsion can be secured by filling the upturned ear with warm water.

BOXING THE EARS.

Happily the coarse and cruel practice of boxing and pulling the ears as a means of corporal punishment in the schools is nowadays seldom heard of; a few instances only have come to my knowledge through the reports of hospital patients; among common people, however, it is not unusual to find the drum-head ruptured by a blow inflicted by the hand of an enraged parent, and, as there is reason to believe that injuries of this kind are not always reported, we probably see only the severer cases. Death has resulted from a blow upon the ear; in any case the drum-head is liable to be ruptured and hearing permanently impaired.

Punishment cannot be safely inflicted by boxing the ears, and pulling the auricle even is not only very painful, but is sometimes followed by injury to the deeper seated parts.

STREET NOISES.

Some of the school-houses of cities are necessarily erected in the noisy districts, for they must be near to the homes of the pupils. The unremitting din of street noises is undoubtedly distracting, especially when the doors and windows have to be kept open; such sounds fatigue the mind, however familiar they may be. The discomfort from this cause should be considered in selecting the site for a building, and the construction of pavements which allow of the noiseless passage of vehicles in the immediate neighborhood would be advisable.

THE PHYSICAL WELL BEING OF PUPILS.

The question of the accountability of the public schools for the physical as well as intellectual improvement of children is, to some extent, a debatable one; it is a matter that seems to depend, in many instances, on the sense of duty that inspires the management of particular schools, inasmuch as the recommendations for the guidance of teachers concerning hygienics are entirely inadequate. The writer believes that, as regards the more unfortunate children of the very poor—the unwashed of both body and raiment—no inconsiderable number of them would be more benefited by personal hygiene than by mental training; at least the two should go hand in hand in every instance, for *Mens sana in corpore sano.*

The chief object of the public school system being the elevation of the entire population, thus placing them beyond the boundary of charitable support, their bodily well being must be assured by influences brought to bear during the formative period of life.

Children whose hearing has been impaired by scarlet fever, measles, or other diseases of youth, are very often neglected by parents who have neither the knowledge nor the time to give them proper care; or their ears have been purposely "let alone" by the physician's advice; these, when sent to school, greatly annoy the teacher by the vexatious delays which their instruction occasions and by the hindrance they are to others. Notwithstanding the fact that the neglect of parents and

physicians throws increased labor on the teacher, he must take some action respecting this class; for, besides being deaf, many of them suffer from offensive discharges, which are not only an evidence of the progress of aural disease, but are very objectionable to cleanly children who are obliged to sit near them. In numerous instances the teacher may find that his pupils are exceedingly deaf without being aware of the defect themselves; the present writer has known children who could not understand a word spoken to them to remain in school for years without any efforts being made to better their condition; they were regarded as defective in intellect.

Whatever rules may be established to meet the exigencies arising out of deafness in the schools, the teacher may do much to ameliorate the condition of these unfortunate people by making himself conversant with their wants and by prudent and considerate treatment of them while under his charge; and by the enforcement of hygienic regulations a great deal may be accomplished in the way of prevention.

CONCLUDING REMARKS.

The enumeration of all the influences which are liable to affect the sense of hearing in children would be difficult in a paper like this; indeed, when it is seen that no one unhealthy organ can fail to have a deleterious effect on some other organ or on the whole system, there must be a limit to the discussion of the consequences thereof on the ear; enough has been said, the writer trusts, to impress on those concerned the importance of care, combined with a certain degree of solicitude, in the management of the class under consideration; otherwise great injustice may be done them.

In their examinations, deaf children, notwithstanding their defects, may come forward well prepared; but if examined in a hasty or impatient manner, the teacher's questions are liable not to be heard well enough to elicit correct answers, and they are thus unable to secure a promotion which their preparation has justly entitled them to receive.

The surroundings of these children are in every way discouraging; they are disheartened both at home and at school, subjected, as they are, to the jeers, ridicule, and mockery of their companions and to the punishment of parents and teachers for seeming inattention and dulness.

Their inability to hear much of what is said to them, the difficulty they experience in the correct enunciation of words when the vocal organs are deficient, and the dismay occasioned by autophonous hearing and noises in the head, either singly or combined, are sufficient to entirely discourage these sufferers. That they become distrustful, deceitful, and vicious in character is to be expected.

Seeming inattention and dulness arise from the inability to hear, and when proper training has been wanting both at home and at school, in many instances the child will naturally accept the situation and cease to be attentive; it is important, therefore, to maintain the child's inter-

est in instruction by special methods, which shall not permit any slurring work to be done by either teacher or pupil.

Dumbness, so called, proceeds from the indescribable sensation experienced by the child in hearing its own voice within the head or as the voice of a person at a distance; these phenomena of the voice very often confound even the most intelligent person, so difficult is it to understand why such seeming strange alterations in the voice should occur.

When the child experiences autophonous voice, it fancies that it has been deprived of the ability to speak, for, to it, the voice seems to fail of utterance;[1] it now becomes convinced that it is "dumb," and with the feeling comes the peculiar "dumb" expression. But this is by no means always the entire experience of the sufferer, for the voice, which has been said to seem to fail of utterance, seems to ascend into the head, where its unusual reverberations give rise to the belief that the head is "hollow" or "empty." These are alarming symptoms, and, inasmuch as they recur with every attempt at speech, the child fears to make an effort which is attended by such disagreeable symptoms.

Noises in the head are seldom absent when autophony exists. The character of the noise depends very much on the imagination of the patient, and may, therefore, be said to be variable; but it is also influenced greatly by changes in the transmitting mechanism. In the worst cases the patient hears the rushing of a railway train in the head or the raging of a storm; these noises are attended by sounds of ringing bells, pattering hail or rain, &c. When the patient has an interval of relief the noises are more bearable; they may then be likened to the gentle sighing of the wind among the trees, the play of the surf on the sandy beach, the singing of the tea kettle, the buzzing of insects, &c. Patients usually describe these noises as resembling some familiarly remembered sound; thus the distant roar of a waterfall occurs to one or the pattering rain to another whose memory goes back to the days when he slept just beneath the roof. But very often the imagination fails to aid in the description, and with children the difficulties in the way of finding out their feeling are almost insurmountable.

When we come to consider what effect these various experiences must have on the minds of children,[2] our sympathies should be enlisted in their behalf to the last degree and our patience should be without limit; in a word, when no apparent cause for a child's dulness of action is known to exist, let there be made a thorough investigation into the condition of the acoustic organs before necessarily regarding it as a dunce or feeble-minded.

[1] The reader will please remember that, although persons with autophonous voice fancy that they are dumb, or at least dumb in some degree, yet their voice is in reality plainly heard by others.

[2] The hearing of the greater number of children who have these autophonous experiences remains pretty good as regards what is said to them most of the time; but when suffering from an aggravation of the trouble the noises in the head cause temporary interference, and then greater deafness is experienced.

APPENDIX.

The following tables exhibit the results of twenty examinations made by the author in the New York public and Roman Catholic parochial schools, with the view of ascertaining the hearing power of the pupils.

Tables I to XII, inclusive, show the number of children examined in the colored public schools.

Tables XIII to XVII, inclusive, show the number examined in the Roman Catholic parochial schools.

Tables XVIII to XX, inclusive, show the number examined in the white public schools.

These examinations are not offered as complete, but rather as pioneering efforts which were made by the writer under difficulties.

Differences in the examiner's tone of voice and in the acoustic properties of the rooms prevented uniform results from being obtained. It is a noteworthy fact, however, that about the same ratio of caraches previously experienced was found in all the classes where inquiries on that point were made. From this the inference may be drawn that the etiological factors were similar and that about the average amount of injury to the ear had, therefore, occurred in every class. No attempt was made in these examinations to record the lesser aural defects, which when present are by no means unimportant.

It will be observed that in all the examinations the teachers and pupils were seldom aware that any deafness existed.

Tables showing the results of examinations as to the hearing power of school pupils.

Table.	Number of classes examined.	Number in class.	Sex of class.	Average age of class.	Name of school.	Date of examination.	Degree of impairment of hearing for the voice.
I.	1	29	M. & F.	About 14	Grammar department of Colored Grammar School No. 3.	Apr. 23, 1880	Case 1. Female. Hears loud voice only in the right ear: ordinary voice in the left ear. Case 2. Male. Hears loud voice only in the left ear: ordinary voice in the right ear.

REMARKS.—The teacher who examined this class had a low and soft but distinct voice, and asked the children familiar questions only; they were not required to repeat any test questions that would tax the memory. A very considerable number of them had the sentences repeated several times before they were understood. The teacher said that she had never before observed any deafness in the class. The children were mostly mulattoes; thirteen of the number recollected having had earaches, and it is probable that but few of these possessed normal hearing.

II.	1	18	M. & F.	About 13	Grammar department of Colored Grammar School No. 3.	Apr. 23, 1880	Case 1. Hears loud voice only in the left ear; ordinary voice in the right ear.

REMARKS.—The teacher was not aware that any of the pupils were hard of hearing. Thirteen of this class stated that they had previously experienced earaches.

III.	2	25	.....	About 11	Primary department of Colored Grammar School No. 3.	Apr. 23, 1880	Case 1. Hears loudest voice only in each ear: occupies a front seat.

REMARKS.—Fifteen of the children composing these two classes had experienced earaches.

IV.	2	38	.....	.....	Primary department of Colored Grammar School No. 3.	Apr. 23, 1880	Case 1. Hears loud voice only in the left ear; ordinary in the right ear.

REMARKS.—The teachers, when first asked, were unaware of any deafness in these classes, but afterward recalled the above case. Twelve of these children recollected having experienced earaches. These were among the youngest children in the school, and I was unable to determine in doubtful cases whether the failure to reply correctly was owing to want of intelligence or to impairment of hearing.

V.	1	15	.....	11	Grammar department of Colored Grammar School No. 3.	Apr. 27, 1880	Case 1. Many years deaf. Hears only loudest voice in the right ear, and loud voice only in the left ear.

REMARKS.—The teacher was aware of this one case; he was, she said, a "little deaf," and being a mischievous boy he was required to occupy a back seat. Four of these pupils stated that they had suffered with earaches.

VI.	1	21	.....	About 12	Grammar department of Colored Grammar School No. 3.	Apr. 27, 1880	None of the pupils of this class were found to have any marked impairment of hearing for the voice.

REMARKS.—Twelve of these pupils stated that they had experienced earaches.

VII.	2	23	.....	15	Grammar department of Colored Grammar School No. 3.	Apr. 27, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the left ear; ordinary voice in the right ear.

REMARKS.—These two deaf pupils were mulattoes. The teachers were not aware before the examination of the presence of any deaf pupils in these classes. None of the pupils themselves were aware that they had any aural defects, nor did any of them remember having experienced earaches. Some of the pupils were over eighteen years of age, and seem to have forgotten these very common experiences of youth.

VIII.	2	63	M. & F.	7 to 12	Primary department of Colored Grammar School No. 3.	Apr. 27, 1880	Case 1. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 2. Hears loud voice only in both of the ears. Case 3. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 4. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 5. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 6. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 7. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 8. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 9. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 10. Hears loud voice only in both of the ears.

REMARKS.—Six of these pupils were mulattoes, one of them was quite dark, and the color of the other three was not noted. The teachers had been unaware of any case of deafness among these pupils, and but two of the pupils themselves were aware that they were hard of hearing. Eighteen of the number had experienced earaches.

IX.	1	14	....	14	Grammar department of Colored Grammar School No. 3.	May 19, 1880	Case 1. Hears shouted voice only in the right ear; loud voice only in the left ear. Case 2. Hears loud voice only in both of the ears.

REMARKS.—One of these pupils was a mulatto, the other was dark colored. Neither the teacher nor any of the pupils knew of any deafness in the class before the examination.

Tables showing the results of examinations as to the hearing power of school pupils—Continued.

Table.	Number of classes examined.	Number in class.	Sex of class.	Average age of class.	Name of school.	Date of examination.	Degree of impairment of hearing for the voice.
X.	1	33	.....	12	Grammar department of Colored Grammar School No. 3.	May 19, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear.

REMARKS.—This pupil was a mulatto. The teacher of this class once had a pupil who was temporarily deaf, but she knew of no deafness in the class at the time of the examination. The pupils themselves were not aware of any case of hardness of hearing in the class; nine of them, however, had experienced earaches previous to this examination.

XI.	1	28	.....	6 to 10	Grammar department of Colored Grammar School No. 3.	May 19, 1880	None of these pupils were found to have impaired hearing for the voice.

REMARKS.—Neither the teacher nor any of the children themselves knew of any case of deafness in this class. Fifteen of the pupils stated that they had experienced earaches.

XII.	1	23	.....	6 to 9	Primary department of Colored Grammar School No. 3.	May 19, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 3. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 4. Hears shouted voice only in the right ear; ordinary voice in the left ear.

REMARKS.—Two of these pupils were mulattoes, one was dark, and the color of the other was not noted. The teacher knew of no cases of impairment of hearing before the examination was made; one of the pupils only was aware of his own deafness. Ten of this class stated that they had previously experienced earaches.

XIII.	1	35	F.	8 to 12	Roman Catholic parochial school of the Church of the Assumption.	May 18, 1880	Case 1. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 2. Hears loud voice only in both of the ears. Case 3. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 4. Hears loud voice only in the right ear; ordinary voice in the left ear.

REMARKS.—The teacher was not previously aware that any of the pupils had imperfect hearing nor were the pupils themselves. Sixteen of them remembered having had earaches.

XIV.	1	40	F.	9 to 13	Roman Catholic parochial school of the Church of the Assumption.	May 18, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the right ear; ordinary voice in the left ear.

REMARKS.— Neither the teacher nor the pupils themselves were aware of any impairment of hearing in the class. Five of the pupils stated that they had suffered with earaches.

XV.	1	48	M.	9 to 13	Roman Catholic parochial school of the Church of the Assumption.	May 18, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the right ear; ordinary voice in the left ear.

REMARKS.— Neither the teacher nor the pupils themselves were aware that any deafness existed in the class. Thirteen of the pupils had had earaches.

XVI.	1	48	M. & F.	8 to 12	Roman Catholic parochial school of the Church of the Assumption.	May 21, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 3. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 4. Hears loud voice only in the right ear; shouted voice in the left ear. Case 5. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 6. Hears loud voice only in both of the ears. Case 7. Hears loud voice only in both of the ears; does not hear any sentence completely. Case 8. Hears loud voice only in both of the ears. Case 9. Hears loud voice only in both of the ears. Case 10. Hears loud voice only in the right ear; shouted voice only in the left ear. Case 11. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 12. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 13. Hears loud voice only in the left ear; ordinary voice in the right ear.

REMARKS. The teacher was not previously aware that any of the pupils were deaf. Five of the pupils stated that they were previously aware of having defects in hearing

Tables showing the results of examinations as to the hearing power of school pupils—Continued.

Table.	Number of classes examined.	Number in class.	Sex of class.	Average age of class.	Name of school.	Date of examination.	Degree of impairment of hearing for the voice.
XVII.	1	55	M. & F.	6 to 11	Roman Catholic parochial school of the Church of the Assumption.	May 21, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 3. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 4. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 5. Hears loud voice only in both of the ears. Case 6. Hears shouted voice only in the left ear; ordinary voice in the right ear. Case 7. Hears loud voice only in both of the ears. Case 8. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 9. Hears shouted voice only in the right ear; loud voice in the left ear. Case 10. Hears shouted voice only in the left ear; loud voice only in the right ear. Case 11. Hears shouted voice only in both of the ears. Case 12. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 13. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 14. Hears loud voice only in both of the ears. Case 15. Hears shouted voice only in the left ear; ordinary voice in the right ear.

REMARKS.—The teacher never regarded any of the class as hard of hearing. Eighteen of the pupils had experienced earaches.

XVIII.	1	27	M.	11 to 15	Grammar School No. 35, New York Public Schools.	Mar. 5, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears shouted voice only in the right ear; ordinary voice in the left ear.

REMARKS.—The teacher was not aware of any deafness in the class previous to the examination. This class of boys is particularly bright; it is recruited from the well-to-do class of citizens. Mr. Henry E. Pellew, a commissioner of education, who kindly accompanied the author, inquired of these boys if any of them were hard of hearing; eleven of them said they were. This apparent discrepancy between the recorded result of the examination and the replies given to Mr. Pellew's inquiry is accounted for by the fact that the teacher's voice was loud and distinct and he had endeavored to put the questions plainly.

XIX.	1	27	M.	11 to 15	Grammar School No. 35, New York Public Schools.	Mar. 5, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. No hearing remains in the right ear; hears shouted voice only in the left ear.

REMARKS.—Neither the teacher nor the pupils themselves were aware that any case of deafness existed in the class. The examination of this class took place in the presence of Mr. Henry E. Pellew, one of the commissioners of education. Cases of slight impairment were not noted.

XX.	1	29	M.	10 to 13	Grammar School No. 21, Ne York Public Schools.	Feb. —, 1880	Case 1. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 2. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 3. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 4. Hears shouted voice only in the left ear; ordinary voice in the right ear.[1] Case 5. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 6. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 7. Hears loud voice only in the left ear; ordinary voice in the right ear. Case 8. Hears shouted voice only in the left ear; ordinary voice in the right ear. Case 9. Hears loud voice only in the right ear; ordinary voice in the left ear. Case 10. Subject to colds in the head, when he cannot hear loud voice in the right e r. Case 11. Hears loud voice only in the left ear; ordinary voice in the right ear.

[1]Case 4 was suffering with a severe cold in the head at the time of the examination.

REMARKS.—The hearing of this class was tested by the teacher, who gave the pupils short sentences to repeat from a newspaper. He ascribed some of the failures to repeat the sentences to their length. One of the boys found to be deaf had always been regarded as a dull pupil; his seat was on the fourth row from the front.